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Pasumarthi et al.

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(54) **APPARATUS AND METHOD FOR SCHEDULING CELL BROADCAST MESSAGES**

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H04W 72/00 (2009.01)

(52) **U.S. Cl.**
CPC ***H04W 72/005*** (2013.01)

(58) **Field of Classification Search**
USPC 455/450; 370/329, 312; 380/270; 340/7.45
See application file for complete search history.

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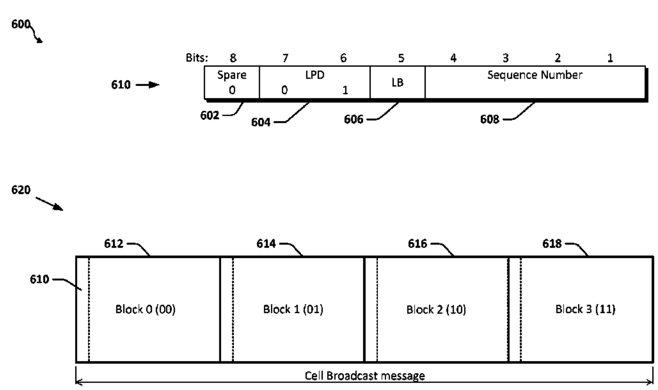
(57) **ABSTRACT**

Methods, apparatus, and computer readable storage media are described. The apparatus may receive a next cell broadcast message or a schedule message according to schedule information in first-received cell broadcast message. The schedule information may indicate timing of the next cell broadcast message or the schedule message. The first cell broadcast message may be received before timing information associated with a cell broadcast channel is known, including after a reselection procedure or after termination of a voice call. The schedule information may relate to a discontinuous reception schedule defined in a missed schedule message. Presence of the schedule information in the first cell broadcast message may be indicated in a page parameter of a header of the first cell broadcast message or in a block identifier of the first cell broadcast message. A network entity is described that adds the schedule information to the first cell broadcast message.

21 Claims, 11 Drawing Sheets



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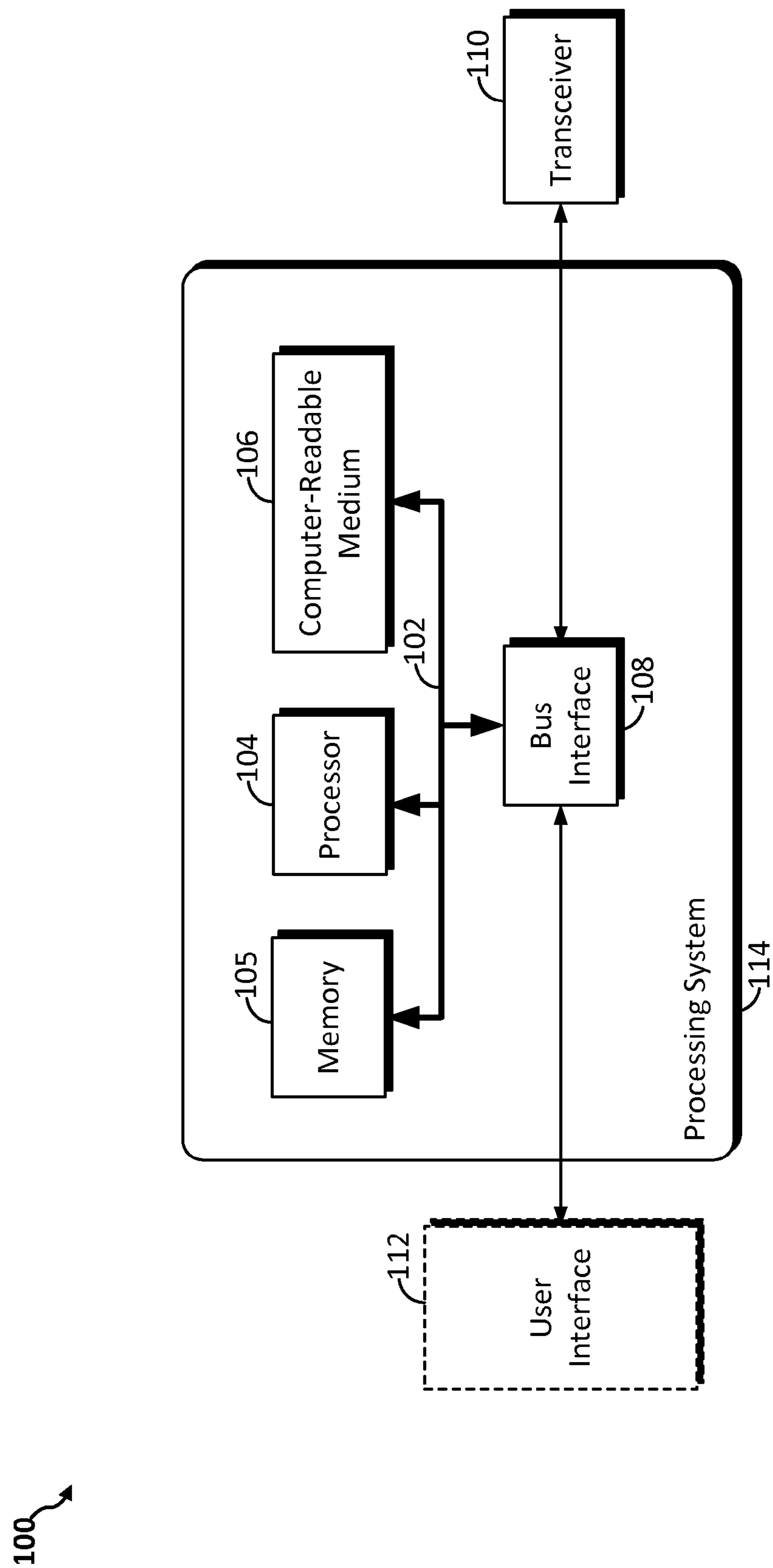

Transceiver
110
Computer-Readable Medium
106
102
Processor
104
Memory
105
Bus Interface
108
Processing System
114
User Interface
112
100

FIG. 1

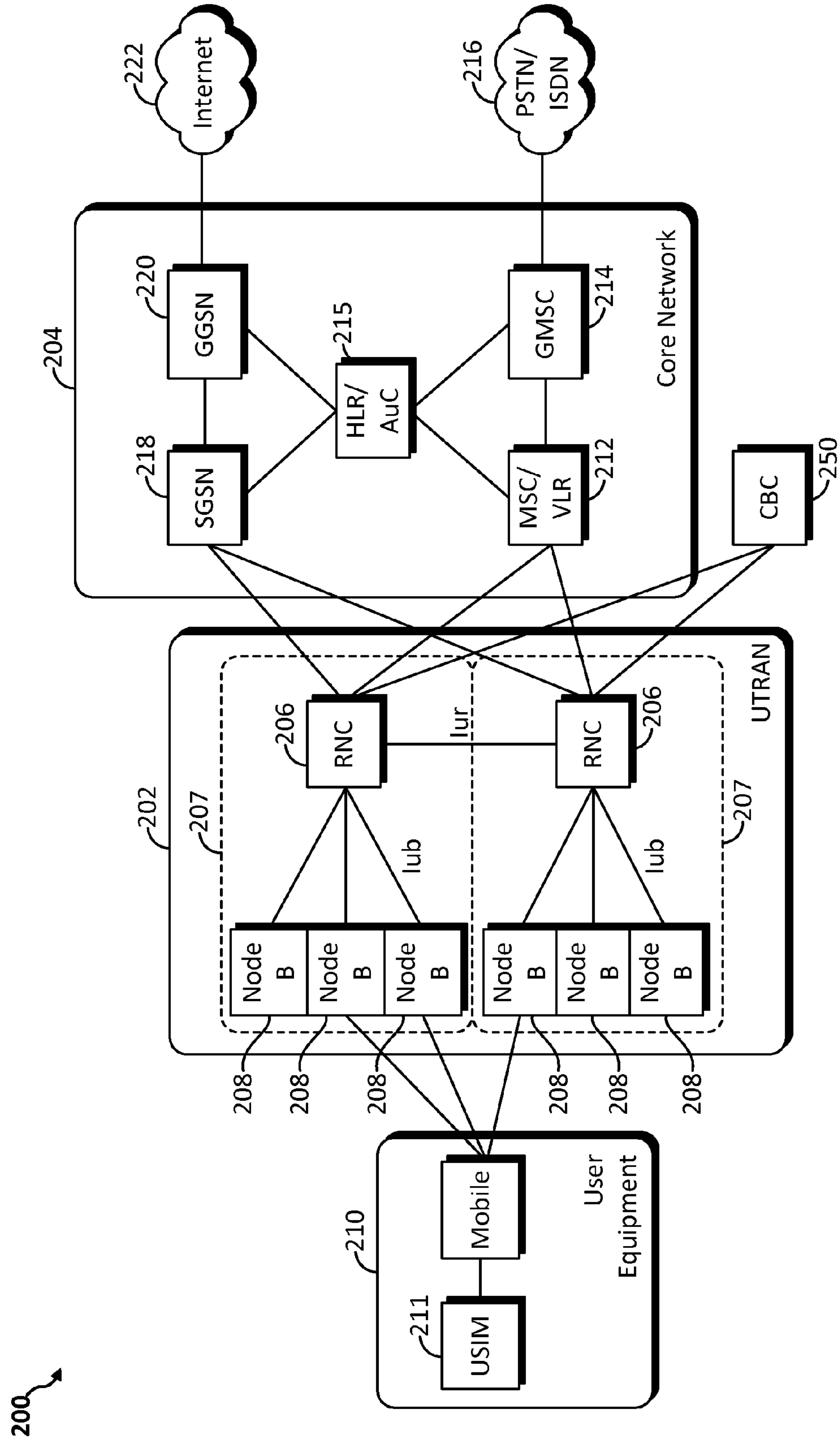

200
Internet
222
PSTN/ ISDN
216
204
GGSN
220
SGSN
218
HLR/ AuC
215
GMSC
214
MSC/ VLR
212
Core Network
CBC
250
202
UTRAN
RNC
206
Iur
Iub
207
Node B
208
User Equipment
Mobile
USIM
211
210

FIG. 2

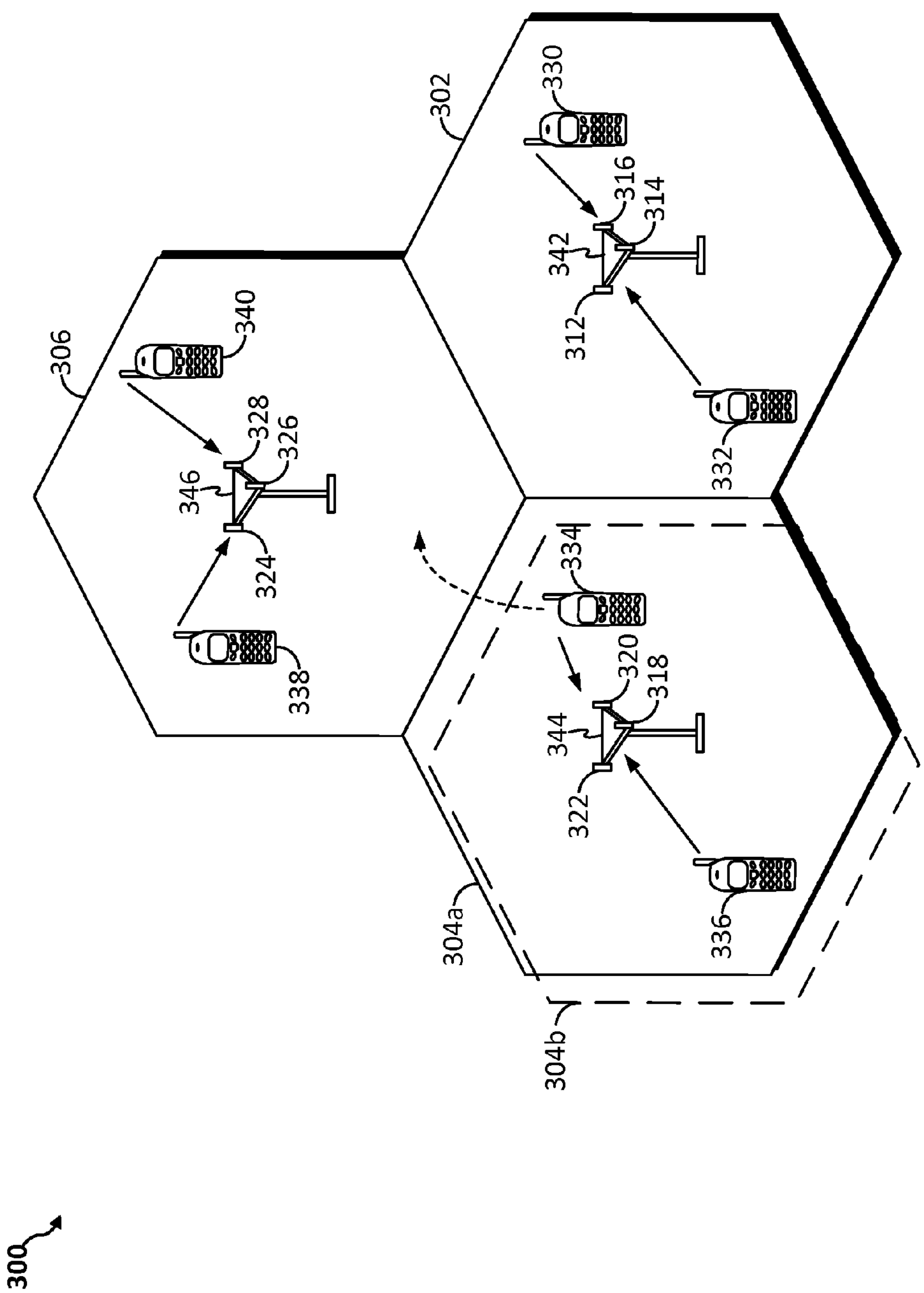
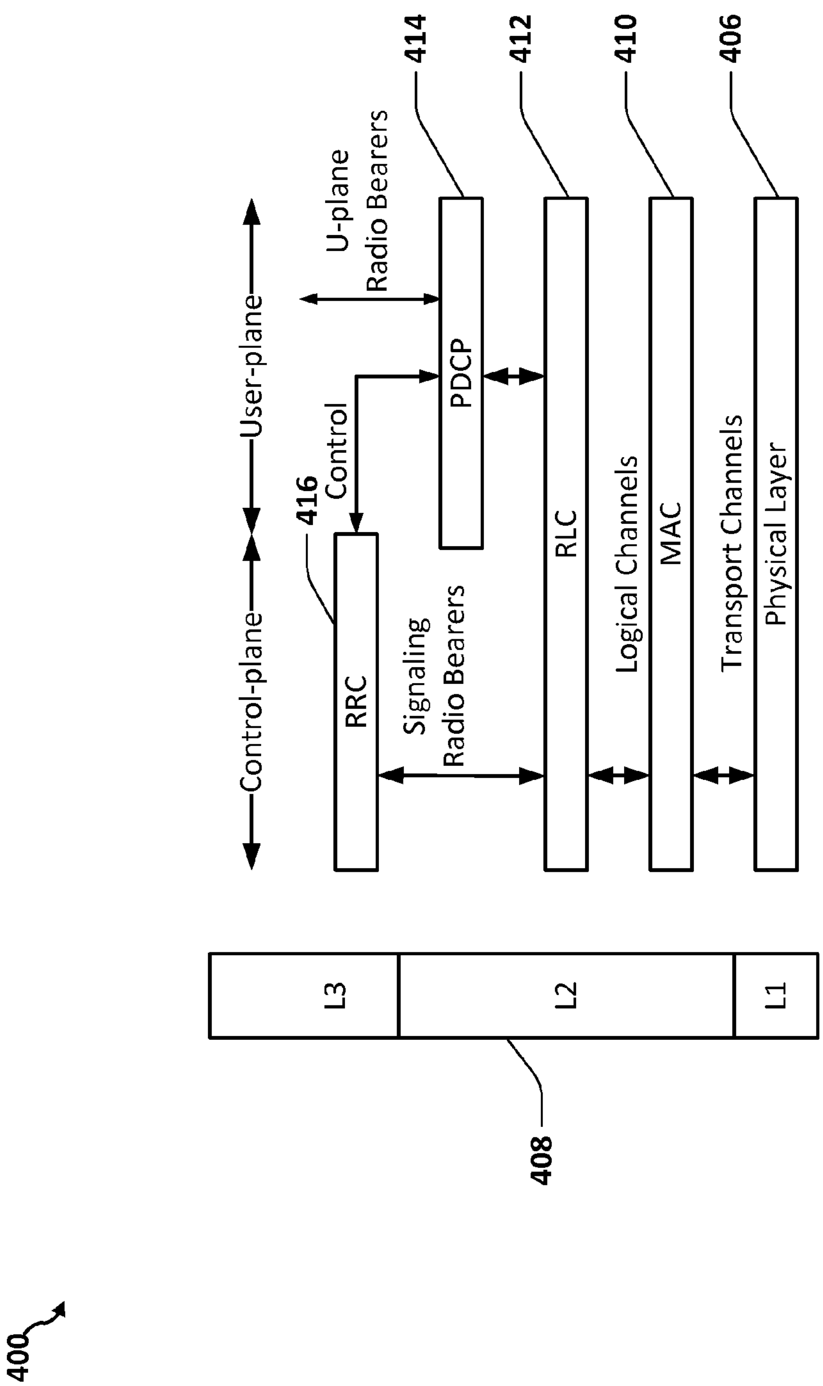

300
302
304a
304b
306
312
314
316
318
320
322
324
326
328
330
332
334
336
338
340
342
344
346

FIG. 3



400
408
L3
L2
L1
Control-plane
User-plane
416
RRC
Control
PDCP
414
U-plane
Radio Bearers
Signaling
Radio Bearers
RLC
412
Logical Channels
MAC
410
Transport Channels
Physical Layer
406

FIG. 4

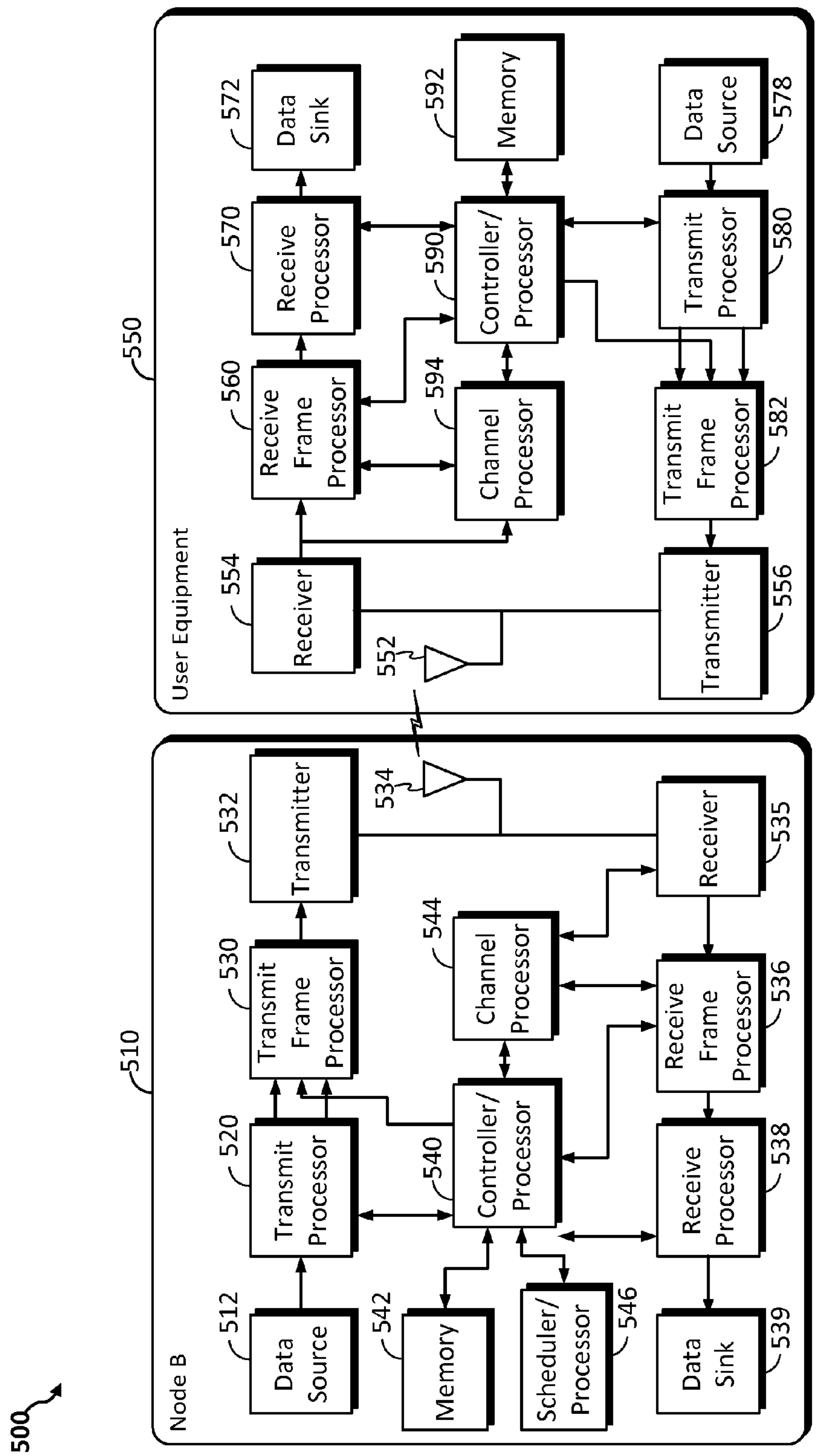
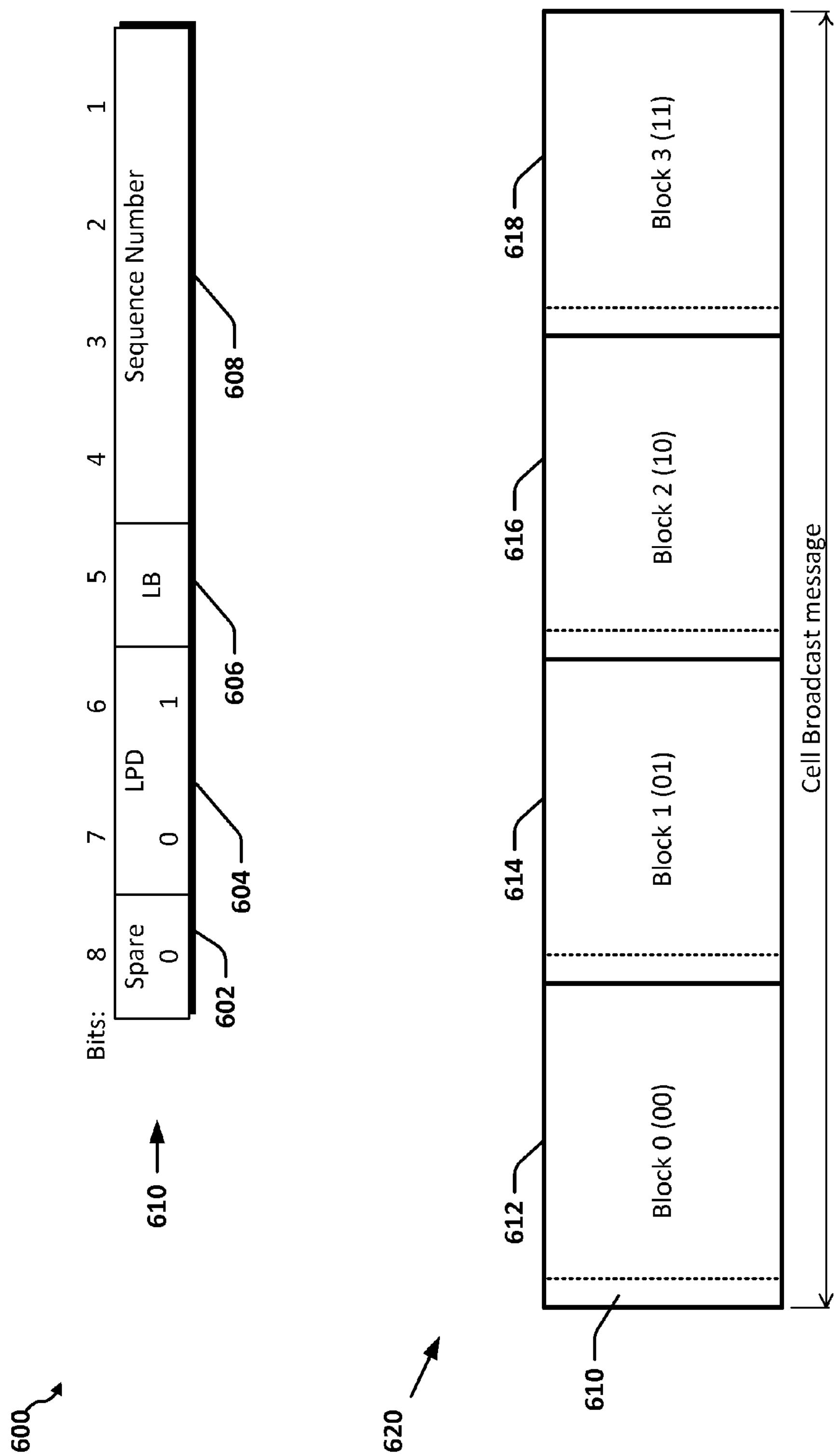

500
Node B
510
Data Source
512
Transmit Processor
520
Transmit Frame Processor
530
Transmitter
532
534
Memory
542
Controller/ Processor
540
Channel Processor
544
Scheduler/ Processor
546
Data Sink
539
Receive Processor
538
Receive Frame Processor
536
Receiver
535
User Equipment
550
Receiver
554
552
Receive Frame Processor
560
Receive Processor
570
Data Sink
572
Channel Processor
594
Controller/ Processor
590
Memory
592
Transmitter
556
Transmit Frame Processor
582
Transmit Processor
580
Data Source
578

FIG. 5



600
620
610
Bits:
8
7
6
5
4
3
2
1
Spare
0
LPD
0
1
LB
Sequence Number
602
604
606
608
Block 0 (00)
Block 1 (01)
Block 2 (10)
Block 3 (11)
612
614
616
618
Cell Broadcast message

FIG. 6

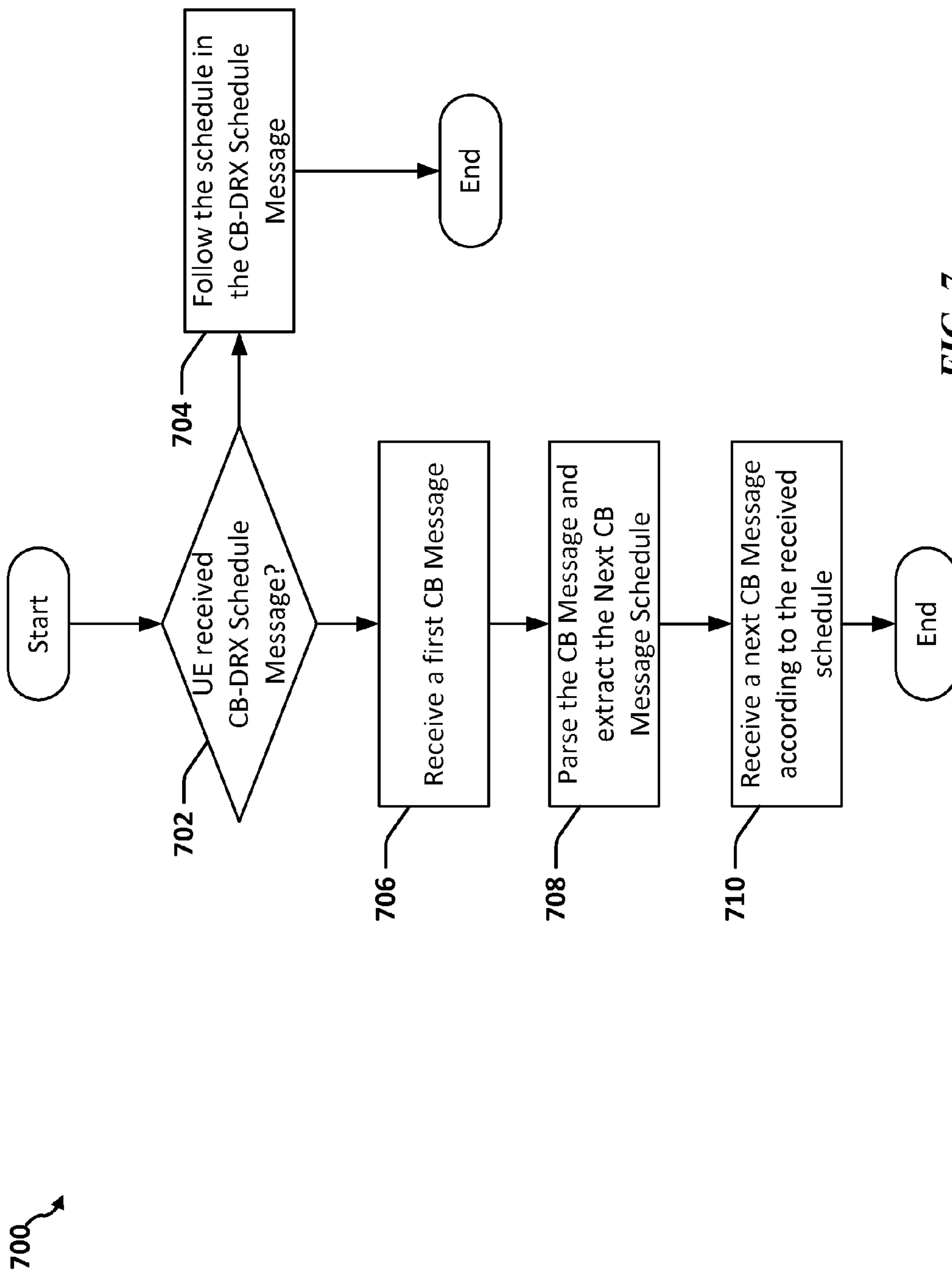

700
Start
UE received CB-DRX Schedule Message?
702
704
Follow the schedule in the CB-DRX Schedule Message
End
Receive a first CB Message
706
Parse the CB Message and extract the Next CB Message Schedule
708
Receive a next CB Message according to the received schedule
710
End

FIG. 7

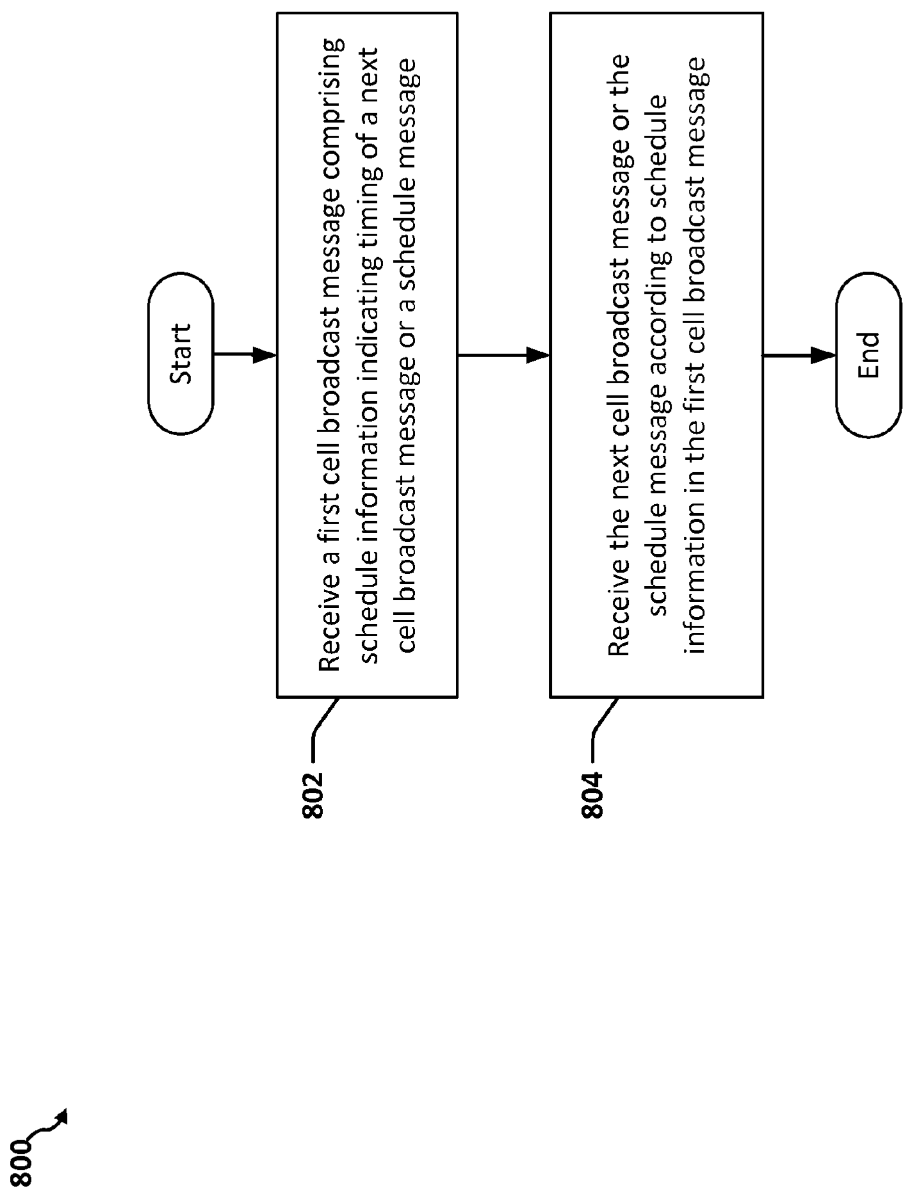

800
Start
802
Receive a first cell broadcast message comprising schedule information indicating timing of a next cell broadcast message or a schedule message
804
Receive the next cell broadcast message or the schedule message according to schedule information in the first cell broadcast message
End

FIG. 8

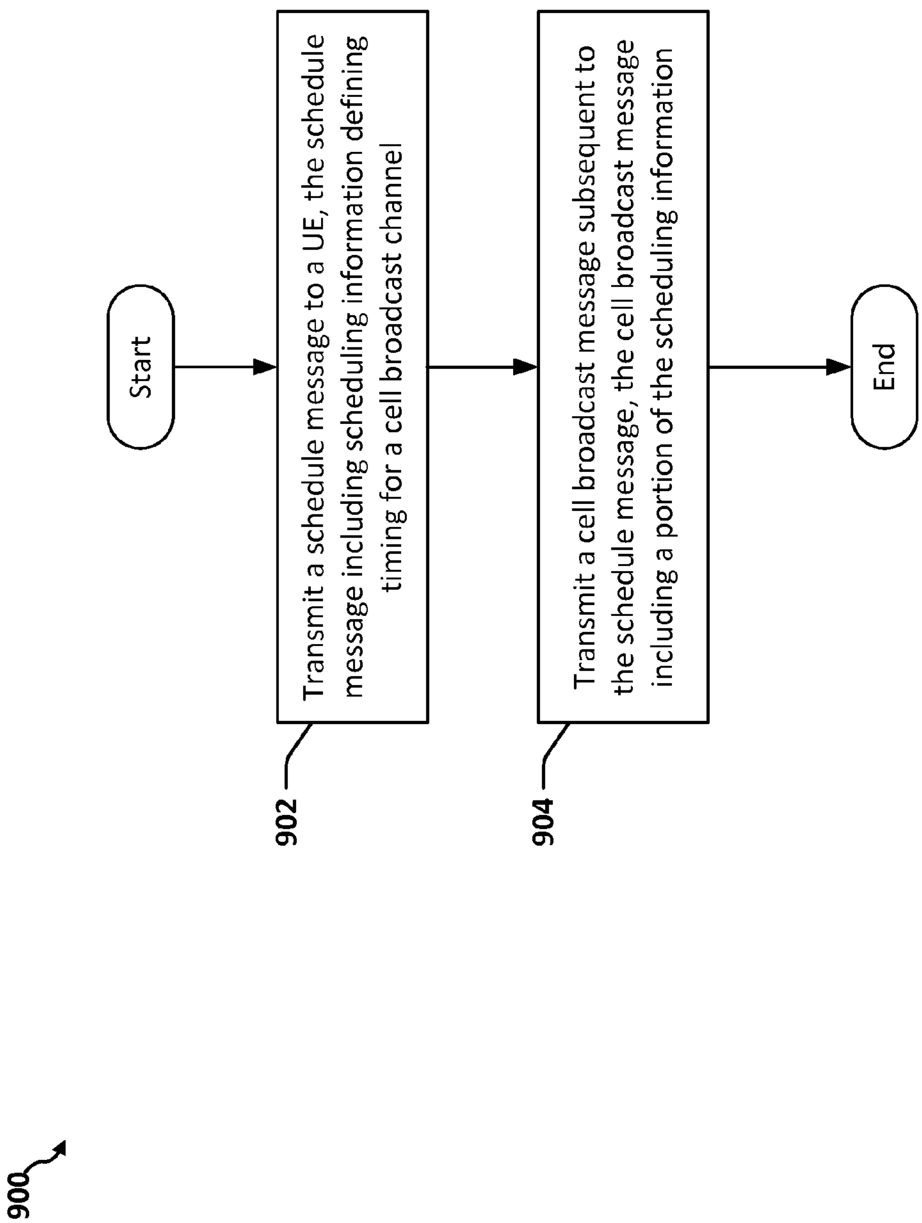

Start
Transmit a schedule message to a UE, the schedule message including scheduling information defining timing for a cell broadcast channel
Transmit a cell broadcast message subsequent to the schedule message, the cell broadcast message including a portion of the scheduling information
End
902
904
900

FIG. 9

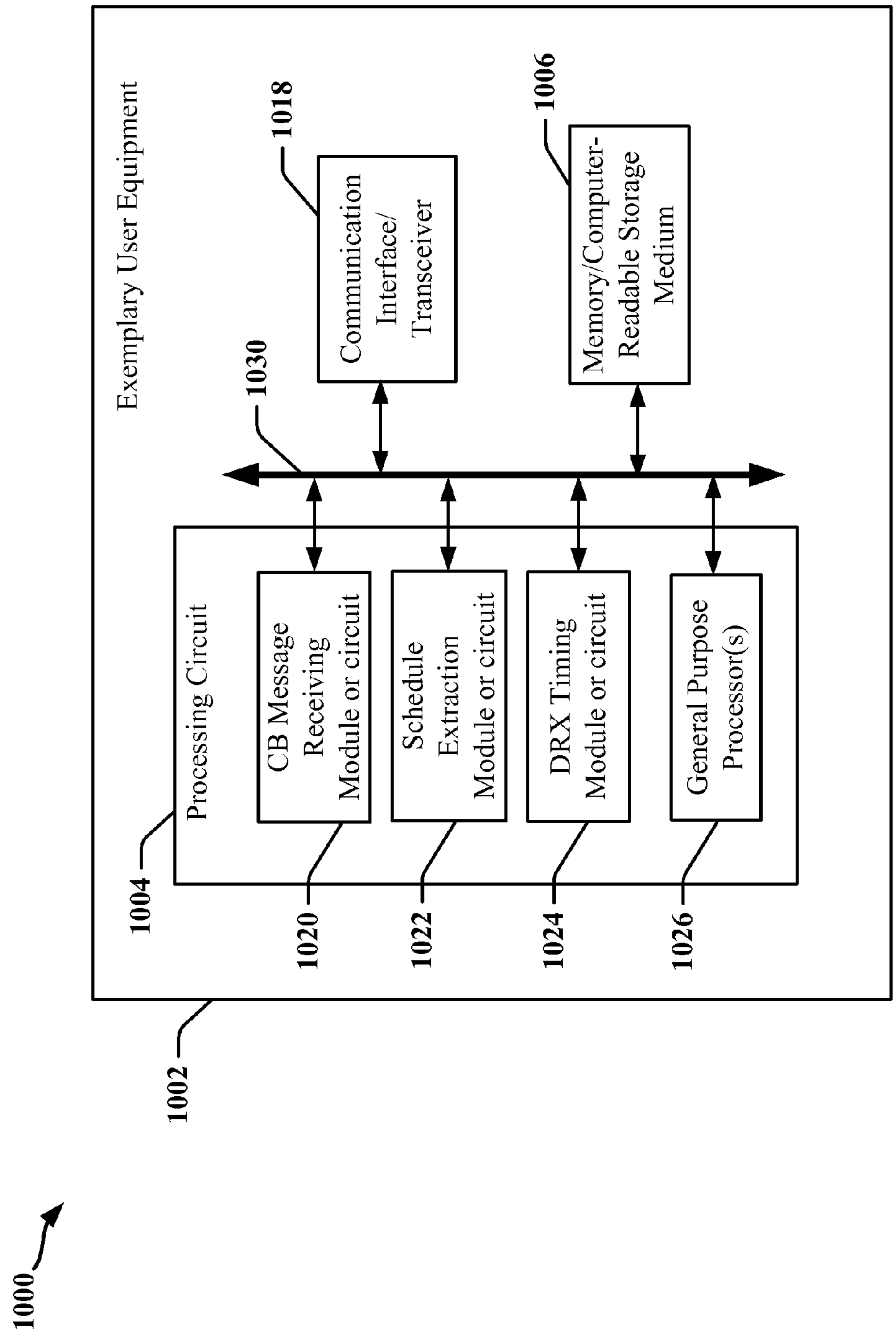
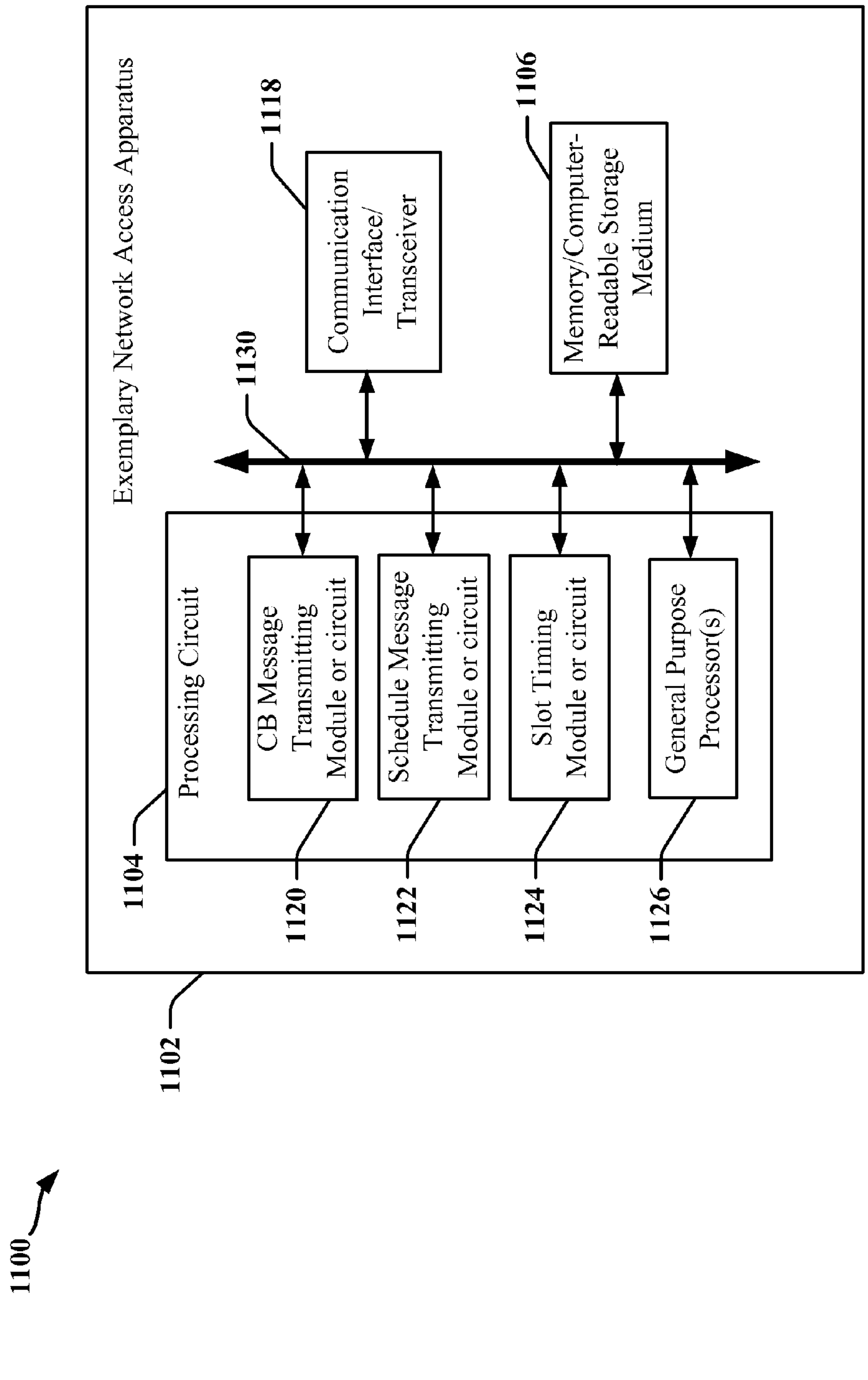

Exemplary User Equipment
Communication Interface/ Transceiver
Memory/Computer-Readable Storage Medium
Processing Circuit
CB Message Receiving Module or circuit
Schedule Extraction Module or circuit
DRX Timing Module or circuit
General Purpose Processor(s)
1000
1002
1004
1006
1018
1020
1022
1024
1026
1030

FIG. 10



Exemplary Network Access Apparatus
Processing Circuit
CB Message Transmitting Module or circuit
Schedule Message Transmitting Module or circuit
Slot Timing Module or circuit
General Purpose Processor(s)
Communication Interface/ Transceiver
Memory/Computer-Readable Storage Medium
1100
1102
1104
1106
1118
1120
1122
1124
1126
1130

FIG. 11

APPARATUS AND METHOD FOR SCHEDULING CELL BROADCAST MESSAGES

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application Ser. No. 61/640,907, entitled "Apparatus And Method For Scheduling Cell Broadcast Messages" and filed on May 1, 2012, which is expressly incorporated by reference herein in its entirety.

BACKGROUND

1. Field

Aspects of the present disclosure relate generally to wireless communication systems, and more particularly, to wireless reception of Cell Broadcast Service messages.

2. Background

Wireless communication networks are widely deployed to provide various communication services such as telephony, video, data, messaging, broadcasts, and so on. Such networks, which are usually multiple access networks, support communications for multiple users by sharing the available network resources. One example of such a network is the UMTS Terrestrial Radio Access Network (UTRAN). The UTRAN is the radio access network (RAN) defined as a part of the Universal Mobile Telecommunications System (UMTS), a third generation (3G) mobile phone technology supported by the 3rd Generation Partnership Project (3GPP). UMTS, which is the successor to Global System for Mobile Communications (GSM) technologies, currently supports various air interface standards, such as Wideband-Code Division Multiple Access (W-CDMA), Time Division—Code Division Multiple Access (TD-CDMA), and Time Division—Synchronous Code Division Multiple Access (TD-SCDMA). UMTS also supports enhanced 3G data communications protocols, such as High Speed Packet Access (HSPA), which provides higher data transfer speeds and capacity to associated UMTS networks.

As the demand for mobile broadband access continues to increase, research and development continue to advance the UMTS technologies not only to meet the growing demand for mobile broadband access, but also to advance and enhance the user experience with mobile communications.

SUMMARY

The following presents a simplified summary of one or more aspects of the present disclosure, in order to provide a basic understanding of such aspects. This summary is not an extensive overview of all contemplated features of the disclosure, and is intended neither to identify key or critical elements of all aspects of the disclosure nor to delineate the scope of any or all aspects of the disclosure. Its sole purpose is to present some concepts of one or more aspects of the disclosure in a simplified form as a prelude to the more detailed description that is presented later.

In one aspect, the disclosure provides a method of wireless communication, including receiving a Cell Broadcast Message comprising schedule information indicating timing of a next Cell Broadcast Message, and receiving the next Cell Broadcast Message according to the received schedule information.

In another aspect, the disclosure provides a user equipment (UE) configured for wireless communication, including at least one processor, a memory coupled to the at least one processor, and a communication interface coupled to the at least one processor. Here, the at least one processor is configured to receive a Cell Broadcast Message comprising schedule information indicating timing of a next Cell Broadcast Message, and to receive the next Cell Broadcast Message according to the received schedule information.

In another aspect, the disclosure provides an apparatus configured for wireless communication, including means for receiving a Cell Broadcast Message comprising schedule information indicating timing of a next Cell Broadcast Message, and means for receiving the next Cell Broadcast Message according to the received schedule information.

In another aspect, the disclosure provides a computer program product, including a computer-readable storage medium having instructions for causing a computer to receive a Cell Broadcast Message comprising schedule information indicating timing of a next Cell Broadcast Message, and to receive the next Cell Broadcast Message according to the received schedule information.

According to certain aspects of the disclosure, a method of wireless communication comprises receiving a first cell broadcast message and receiving a next cell broadcast message or a schedule message according to schedule information in the first cell broadcast message. The schedule information may indicate timing of the next cell broadcast message or the schedule message. The first cell broadcast message may be received before timing information associated with a cell broadcast channel is known. For example, the first cell broadcast message may be received after a reselection procedure or after termination of a voice call. The schedule information in the first cell broadcast message may relate to a discontinuous reception schedule defined in a missed schedule message. Presence of the schedule information in the first cell broadcast message may be indicated in a page parameter of a header of the first cell broadcast message and/or in a block identifier of the first cell broadcast message.

According to certain aspects of the disclosure, a method of wireless communication comprises transmitting a schedule message to a user equipment, and transmitting a cell broadcast message after the schedule message, where the cell broadcast message includes at least a portion of the scheduling information. The schedule message may define timing for a cell broadcast channel. The cell broadcast message may include an indicator of presence of scheduling information in a header of the cell broadcast message. The indicator may be provided in a block type octet or in a page parameter field.

These and other aspects of the invention will become more fully understood upon a review of the detailed description, which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram illustrating an example of a hardware implementation for an apparatus employing a processing system.

FIG. **2** is a block diagram conceptually illustrating an example of a telecommunications system.

FIG. **3** is a conceptual diagram illustrating an example of an access network.

FIG. **4** is a conceptual diagram illustrating an example of a radio protocol architecture for the user and control plane.

FIG. **5** is a block diagram conceptually illustrating an example of a Node B in communication with a UE in a telecommunications system.

FIG. **6** is a schematic diagram of a cell broadcast message according to one example.

FIG. 7 is a flow chart illustrating one example of a process for receiving cell broadcast messages.

FIG. 8 is a flow chart illustrating one example of a process for transmitting cell broadcast messages.

FIG. 9 is a flow chart illustrating a process of transmitting CB Messages in accordance with certain aspects of the present disclosure.

FIG. 10 is a diagram illustrating an example of a hardware implementation for an exemplary user equipment apparatus employing a processing circuit.

FIG. 11 is a diagram illustrating an example of a hardware implementation for an exemplary network access apparatus employing a processing circuit.

DETAILED DESCRIPTION

The detailed description set forth below in connection with the appended drawings is intended as a description of various configurations and is not intended to represent the only configurations in which the concepts described herein may be practiced. The detailed description includes specific details for the purpose of providing a thorough understanding of various concepts. However, it will be apparent to those skilled in the art that these concepts may be practiced without these specific details. In some instances, well-known structures and components are shown in block diagram form in order to avoid obscuring such concepts.

FIG. **1** is a conceptual diagram illustrating an example of a hardware implementation for an apparatus **100** employing a processing system **114**. In accordance with various aspects of the disclosure, an element, or any portion of an element, or any combination of elements may be implemented with a processing system **114** that includes one or more processors **104**. Examples of processors **104** include microprocessors, microcontrollers, digital signal processors (DSPs), field programmable gate arrays (FPGAs), programmable logic devices (PLDs), state machines, gated logic, discrete hardware circuits, and other suitable hardware configured to perform the various functionality described throughout this disclosure.

In this example, the processing system **114** may be implemented with a bus architecture, represented generally by the bus **102**. The bus **102** may include any number of interconnecting buses and bridges depending on the specific application of the processing system **114** and the overall design constraints. The bus **102** links together various circuits including one or more processors (represented generally by the processor **104**), a memory **105**, and computer-readable media (represented generally by the computer-readable medium **106**). The bus **102** may also link various other circuits such as timing sources, peripherals, voltage regulators, and power management circuits, which are well known in the art, and therefore, will not be described any further. A bus interface **108** provides an interface between the bus **102** and a transceiver **110**. The transceiver **110** provides a means for communicating with various other apparatus over a transmission medium. Depending upon the nature of the apparatus, a user interface **112** (e.g., keypad, display, speaker, microphone, joystick) may also be provided.

The processor **104** is responsible for managing the bus **102** and general processing, including the execution of software stored on the computer-readable medium **106**. The software, when executed by the processor **104**, causes the processing system **114** to perform the various functions described infra for any particular apparatus. The computer-readable medium **106** may also be used for storing data that is manipulated by the processor **104** when executing software.

One or more processors **104** in the processing system may execute software.

Software shall be construed broadly to mean instructions, instruction sets, code, code segments, program code, programs, subprograms, software modules, applications, software applications, software packages, routines, subroutines, objects, executables, threads of execution, procedures, functions, etc., whether referred to as software, firmware, middleware, microcode, hardware description language, or otherwise. The software may reside on a computer-readable medium **106**. The computer-readable medium **106** may be a non-transitory computer-readable medium. A non-transitory computer-readable medium includes, by way of example, a magnetic storage device (e.g., hard disk, floppy disk, magnetic strip), an optical disk (e.g., a compact disc (CD) or a digital versatile disc (DVD)), a smart card, a flash memory device (e.g., a card, a stick, or a key drive), a random access memory (RAM), a read only memory (ROM), a programmable ROM (PROM), an erasable PROM (EPROM), an electrically erasable PROM (EEPROM), a register, a removable disk, and any other suitable medium for storing software and/or instructions that may be accessed and read by a computer. The computer-readable medium may also include, by way of example, a carrier wave, a transmission line, and any other suitable medium for transmitting software and/or instructions that may be accessed and read by a computer. The computer-readable medium **106** may reside in the processing system **114**, external to the processing system **114**, or distributed across multiple entities including the processing system **114**. The computer-readable medium **106** may be embodied in a computer program product. By way of example, a computer program product may include a computer-readable medium in packaging materials. Those skilled in the art will recognize how best to implement the described functionality presented throughout this disclosure depending on the particular application and the overall design constraints imposed on the overall system.

The various concepts presented throughout this disclosure may be implemented across a broad variety of telecommunication systems, network architectures, and communication standards. Referring now to FIG. **2**, as an illustrative example without limitation, various aspects of the present disclosure are illustrated with reference to a Universal Mobile Telecommunications System (UMTS) system **200**. A UMTS network includes three interacting domains: a core network **204**, a radio access network (RAN) (e.g., the UMTS Terrestrial Radio Access Network (UTRAN) **202**), and a UE **210**. Among several options available for a UTRAN **202**, in this example, the illustrated UTRAN **202** may employ a W-CDMA air interface for enabling various wireless services including telephony, video, data, messaging, broadcasts, and/or other services. The UTRAN **202** may include a plurality of Radio Network Subsystems (RNSs) such as an RNS **207**, each controlled by a respective Radio Network Controller (RNC) such as an RNC **206**. Here, the UTRAN **202** may include any number of RNCs **206** and RNSs **207** in addition to the illustrated RNCs **206** and RNSs **207**. The RNC **206** is an apparatus responsible for, among other things, assigning, reconfiguring, and releasing radio resources within the RNS **207**. The RNC **206** may be interconnected to other RNCs (not shown) in the UTRAN **202** through various types of interfaces such as a direct physical connection, a virtual network, or the like using any suitable transport network.

The geographic region covered by the RNS **207** may be divided into a number of cells, with a radio transceiver apparatus serving each cell. A radio transceiver apparatus is commonly referred to as a Node B in UMTS applications, but may also be referred to by those skilled in the art as a base station (BS), a base transceiver station (BTS), a radio base station, a radio transceiver, a transceiver function, a basic service set (BSS), an extended service set (ESS), an access point (AP), or some other suitable terminology. For clarity, three Node Bs **208** are shown in each RNS **207**; however, the RNSs **207** may include any number of wireless Node Bs. The Node Bs **208** provide wireless access points to a core network **204** for any number of mobile apparatuses. Examples of a mobile apparatus include a cellular phone, a smart phone, a session initiation protocol (SIP) phone, a laptop, a notebook, a netbook, a smartbook, a personal digital assistant (PDA), a satellite radio, a global positioning system (GPS) device, a multimedia device, a video device, a digital audio player (e.g., MP3 player), a camera, a game console, or any other similar functioning device. The mobile apparatus is commonly referred to as UE in UMTS applications, but may also be referred to by those skilled in the art as a mobile station (MS), a subscriber station, a mobile unit, a subscriber unit, a wireless unit, a remote unit, a mobile device, a wireless device, a wireless communications device, a remote device, a mobile subscriber station, an access terminal (AT), a mobile terminal, a wireless terminal, a remote terminal, a handset, a terminal, a user agent, a mobile client, a client, or some other suitable terminology. In a UMTS system, the UE **210** may further include a universal subscriber identity module (USIM) **211**, which contains a user's subscription information to a network. For illustrative purposes, one UE **210** is shown in communication with a number of the Node Bs **208**. The downlink (DL), also called the forward link, refers to the communication link from a Node B **208** to a UE **210** and the uplink (UL), also called the reverse link, refers to the communication link from a UE **210** to a Node B **208**.

The core network **204** may interface with one or more access networks, such as the UTRAN **202**. As shown, the core network **204** is a UMTS core network. However, as those skilled in the art will recognize, the various concepts presented throughout this disclosure may be implemented in a RAN, or other suitable access network, to provide UEs with access to types of core networks other than UMTS networks.

The illustrated UMTS core network **204** includes a circuit-switched (CS) domain and a packet-switched (PS) domain. Some of the circuit-switched elements are a Mobile services Switching Centre (MSC), a Visitor Location Register (VLR), and a Gateway MSC (GMSC). Packet-switched elements include a Serving GPRS Support Node (SGSN) and a Gateway GPRS Support Node (GGSN). Some network elements, like EIR, HLR, VLR, and AuC may be shared by both of the circuit-switched and packet-switched domains.

In the illustrated example, the core network **204** supports circuit-switched services with a MSC **212** and a GMSC **214**. In some applications, the GMSC **214** may be referred to as a media gateway (MGW). One or more RNCs, such as the RNC **206**, may be connected to the MSC **212**. The MSC **212** is an apparatus that controls call setup, call routing, and UE mobility functions. The MSC **212** also includes a visitor location register (VLR) that contains subscriber-related information for the duration that a UE is in the coverage area of the MSC **212**. The GMSC **214** provides a gateway through the MSC **212** for the UE to access a circuit-switched network **216**. The GMSC **214** includes a home location register (HLR) **215** containing subscriber data, such as the data reflecting the details of the services to which a particular user has subscribed. The HLR is also associated with an authentication center (AuC) that contains subscriber-specific authentication data. When a call is received for a particular UE, the GMSC **214** queries the HLR **215** to determine the UE's location and forwards the call to the particular MSC serving that location.

The illustrated core network **204** also supports packet-switched data services with a serving GPRS support node (SGSN) **218** and a gateway GPRS support node (GGSN) **220**. General Packet Radio Service (GPRS) is designed to provide packet-data services at speeds higher than those available with standard circuit-switched data services. The GGSN **220** provides a connection for the UTRAN **202** to a packet-based network **222**. The packet-based network **222** may be the Internet, a private data network, or some other suitable packet-based network. The primary function of the GGSN **220** is to provide the UEs **210** with packet-based network connectivity. Data packets may be transferred between the GGSN **220** and the UEs **210** through the SGSN **218**, which performs primarily the same functions in the packet-based domain as the MSC **212** performs in the circuit-switched domain.

In a UMTS network that supports Cell Broadcast technology, the RNC **206** may be coupled to a Cell Broadcast Center (CBC) **250**. In one example, the CBC **250** is coupled to the RNC **206** using a standards defined interface, such as an IuBC interface, which may utilize standardized TCP/IP communication. In another example, the CBC **250** may be coupled to a Base Station Controller (BSC) in a GSM network. Typically, the CBC **250** may transmit information to the RNC **206** that relates to a Cell Broadcast Message to be transmitted to the UEs **210**. The UTRAN **202** is one example of a RAN that may be utilized in accordance with the present disclosure.

FIG. **3** is a simplified schematic illustration of a RAN **300** in a UTRAN architecture. The system includes multiple cellular regions (cells), including cells **302**, **304**, and **306**, each of which may include one or more sectors. Cells may be defined geographically (e.g., by coverage area) and/or may be defined in accordance with a frequency, scrambling code, etc. That is, the illustrated geographically-defined cells **302**, **304**, and **306** may each be further divided into a plurality of cells, e.g., by utilizing different scrambling codes. For example, cell **304***a* may utilize a first scrambling code, and cell **304***b*, while in the same geographic region and served by the same Node B **344**, may be distinguished by utilizing a second scrambling code.

In a cell that is divided into sectors, the multiple sectors within a cell can be formed by groups of antennas with each antenna responsible for communication with UEs in a portion of the cell. For example, in cell **302**, antenna groups **312**, **314**, and **316** may each correspond to a different sector. In cell **304**, antenna groups **318**, **320**, and **322** may each correspond to a different sector. In cell **306**, antenna groups **324**, **326**, and **328** may each correspond to a different sector.

The cells **302**, **304**, and **306** may include several UEs that may be in communication with one or more sectors of each cell **302**, **304**, or **306**. For example, UEs **330** and **332** may be in communication with Node B **342**, UEs **334** and **336** may be in communication with Node B **344**, and UEs **338** and **340** may be in communication with Node B **346**. Here, each Node B **342**, **344**, and **346** may be configured to provide an access point to a core network **204** (see FIG. **2**) for all the UEs **330**, **332**, **334**, **336**, **338**, and **340** in the respective cells **302**, **304**, and **306**.

During a call with a source cell, or at any other time, the UE **336** may monitor various parameters of the source cell as well as various parameters of neighboring cells. Further, depending on the quality of these parameters, the UE **336** may maintain communication with one or more of the neighboring cells. During this time, the UE **336** may maintain an Active Set, that is, a list of cells to which the UE **336** is simultaneously connected (i.e., the UTRAN cells that are currently assigning a downlink dedicated physical channel DPCH or fractional downlink dedicated physical channel F-DPCH to the UE **336** may constitute the Active Set).

The UTRAN air interface may comprise a spread spectrum Direct-Sequence

Code Division Multiple Access (DS-CDMA) system and, in one example, may conform or comply with W-CDMA standards. A spread spectrum DS-CDMA may spread user data through multiplication by a sequence of pseudorandom bits called chips. The W-CDMA air interface for the UTRAN **202** may be based on such DS-CDMA technology and may additionally employ frequency division duplexing (FDD) that uses a different carrier frequency for the uplink (UL) and downlink (DL) between a Node B **408** and a UE **210**. Another air interface for UMTS that utilizes DS-CDMA, and uses time division duplexing (TDD), is the TD-SCDMA air interface. Those skilled in the art will recognize that although various examples described herein may refer to a W-CDMA air interface, the underlying principles are equally applicable to a TD-SCDMA air interface or any other suitable air interface.

In a wireless telecommunication system, the communication protocol architecture may take on various forms depending on the particular application. For example, in a 3GPP UMTS system, the signaling protocol stack is divided into a Non-Access Stratum (NAS) and an Access Stratum (AS). The NAS provides the upper layers, for signaling between the UE **210** and the core network **204** (referring to FIG. **2**), and may include circuit switched and packet switched protocols. The AS provides the lower layers, for signaling between the UTRAN **202** and the UE **210**, and may include a user plane and a control plane. Here, the user plane or data plane carries user traffic, while the control plane carries control information (i.e., signaling).

Turning to FIG. **4**, the AS is shown with three layers: Layer **1**, Layer **2**, and Layer **3**. Layer **1** is the lowest layer and implements various physical layer signal processing functions. Layer **1** will be referred to herein as the physical layer **406**. The data link layer, called Layer **2** **408**, is above the physical layer **406** and is responsible for the link between the UE **210** and Node B **208** over the physical layer **406**.

At Layer **3**, the RRC layer **416** handles the control plane signaling between the UE **210** and the Node B **208**. RRC layer **416** includes a number of functional entities for routing higher layer messages, handling broadcasting and paging functions, establishing and configuring radio bearers, etc.

In the illustrated air interface, the L**2** layer **408** is split into sublayers. In the control plane, the L**2** layer **408** includes two sublayers: a medium access control (MAC) sublayer **410** and a radio link control (RLC) sublayer **412**. In the user plane, the L**2** layer **408** additionally includes a packet data convergence protocol (PDCP) sublayer **414**. Although not shown, the UE may have several upper layers above the L**2** layer **408** including a network layer (e.g., IP layer) that is terminated at a PDN gateway on the network side and an application layer that is terminated at the other end of the connection (e.g., far end UE, server, etc.).

The PDCP sublayer **414** provides multiplexing between different radio bearers and logical channels. The PDCP sublayer **414** also provides header compression for upper layer data packets to reduce radio transmission overhead, security by ciphering the data packets, and handover support for UEs between Node Bs.

The RLC sublayer **412** generally supports an acknowledged mode (AM) (where an acknowledgment and retransmission process may be used for error correction), an unacknowledged mode (UM), and a transparent mode for data transfers, and provides segmentation and reassembly of upper layer data packets and reordering of data packets to compensate for out-of-order reception due to a hybrid automatic repeat request (HARQ) at the MAC layer. In the acknowledged mode, RLC peer entities such as an RNC and a UE may exchange various RLC protocol data units (PDUs) including RLC Data PDUs, RLC Status PDUs, and RLC Reset PDUs, among others. In the present disclosure, the term "packet" may refer to any RLC PDU exchanged between RLC peer entities.

The MAC sublayer **410** provides multiplexing between logical and transport channels. The MAC sublayer **410** is also responsible for allocating the various radio resources (e.g., resource blocks) in one cell among the UEs. The MAC sublayer **410** is also responsible for HARQ operations.

FIG. **5** is a block diagram of an exemplary Node B **510** in communication with an exemplary UE **550**, where the Node B **510** may be the Node B **408** in FIG. **4**, and the UE **550** may be the UE **410** in FIG. **4**. In the downlink communication, a transmit processor **520** may receive data from a data source **512** and control signals from a controller/processor **540**. The transmit processor **520** provides various signal processing functions for the data and control signals, as well as reference signals (e.g., pilot signals). For example, the transmit processor **520** may provide cyclic redundancy check (CRC) codes for error detection, coding and interleaving to facilitate forward error correction (FEC), mapping to signal constellations based on various modulation schemes (e.g., binary phase-shift keying (BPSK), quadrature phase-shift keying (QPSK), M-phase-shift keying (M-PSK), M-quadrature amplitude modulation (M-QAM), and the like), spreading with orthogonal variable spreading factors (OVSF), and multiplying with scrambling codes to produce a series of symbols. Channel estimates from a channel processor **544** may be used by a controller/processor **540** to determine the coding, modulation, spreading, and/or scrambling schemes for the transmit processor **520**. These channel estimates may be derived from a reference signal transmitted by the UE **550** or from feedback from the UE **550**. The symbols generated by the transmit processor **520** are provided to a transmit frame processor **530** to create a frame structure. The transmit frame processor **530** creates this frame structure by multiplexing the symbols with information from the controller/processor **540**, resulting in a series of frames. The frames are then provided to a transmitter **532**, which provides various signal conditioning functions including amplifying, filtering, and modulating the frames onto a carrier for downlink transmission over the wireless medium through antenna **534**. The antenna **534** may include one or more antennas, for example, including beam steering bidirectional adaptive antenna arrays or other similar beam technologies.

At the UE **550**, a receiver **554** receives the downlink transmission through an antenna **552** and processes the transmission to recover the information modulated onto the carrier. The information recovered by the receiver **554** is provided to a receive frame processor **560**, which parses each frame, and provides information from the frames to a channel processor **594** and the data, control, and reference signals to a receive processor **570**. The receive processor **570** then performs the inverse of the processing performed by the transmit processor **520** in the Node B **510**. More specifically, the receive processor **570** descrambles and despreads the symbols, and then determines the most likely signal constellation points transmitted by the Node B **510** based on the modulation scheme. These soft decisions may be based on channel estimates computed by the channel processor **594**. The soft decisions are then decoded and deinterleaved to recover the data, control, and reference signals. The CRC codes are then checked to determine whether the frames were successfully decoded. The data carried by the successfully decoded frames will then be provided to a data sink **572**, which represents applications running in the UE **550** and/or various user interfaces (e.g., display). Control signals carried by successfully decoded frames will be provided to a controller/processor **590**. When frames are unsuccessfully decoded by the receiver processor **570**, the controller/processor **590** may also use an acknowledgement (ACK) and/or negative acknowledgement (NACK) protocol to support retransmission requests for those frames.

In the uplink, data from a data source **578** and control signals from the controller/processor **590** are provided to a transmit processor **580**. The data source **578** may represent applications running in the UE **550** and various user interfaces (e.g., keyboard). Similar to the functionality described in connection with the downlink transmission by the Node B **510**, the transmit processor **580** provides various signal processing functions including CRC codes, coding and interleaving to facilitate FEC, mapping to signal constellations, spreading with OVSFs, and scrambling to produce a series of symbols. Channel estimates, derived by the channel processor **594** from a reference signal transmitted by the Node B **510** or from feedback contained in the midamble transmitted by the Node B **510** may be used to select the appropriate coding, modulation, spreading, and/or scrambling schemes. The symbols produced by the transmit processor **580** will be provided to a transmit frame processor **582** to create a frame structure. The transmit frame processor **582** creates this frame structure by multiplexing the symbols with information from the controller/processor **590**, resulting in a series of frames. The frames are then provided to a transmitter **556**, which provides various signal conditioning functions including amplification, filtering, and modulating the frames onto a carrier for uplink transmission over the wireless medium through the antenna **552**.

The uplink transmission is processed at the Node B **510** in a manner similar to that described in connection with the receiver function at the UE **550**. A receiver **535** receives the uplink transmission through the antenna **534** and processes the transmission to recover the information modulated onto the carrier. The information recovered by the receiver **535** is provided to a receive frame processor **536**, which parses each frame, and provides information from the frames to the channel processor **544** and the data, control, and reference signals to a receive processor **538**. The receive processor **538** performs the inverse of the processing performed by the transmit processor **580** in the UE **550**. The data and control signals carried by the successfully decoded frames may then be provided to a data sink **539** and the controller/processor, respectively. If some of the frames were unsuccessfully decoded by the receive processor, the controller/processor **540** may also use an acknowledgement (ACK) and/or negative acknowledgement (NACK) protocol to support retransmission requests for those frames.

The controller/processors **540** and **590** may be used to direct the operation at the Node B **510** and the UE **550**, respectively. For example, the controller/processors **540** and **590** may provide various functions including timing, peripheral interfaces, voltage regulation, power management, and other control functions. The computer readable media of memories **542** and **592** may store data and software for the Node B **510** and the UE **550**, respectively. A scheduler/processor **546** at the Node B **510** may be used to allocate resources to the UEs and schedule downlink and/or uplink transmissions for the UEs.

According to certain aspects of the present disclosure, one or more of the CBC **250**, the RNC **206**, and/or the Node B **208** may be configured to transmit a Cell Broadcast Message having scheduling information as described below. In some aspects of the present disclosure the UE **210** may be configured to receive and parse a Cell Broadcast Message having scheduling information as described below. In particular, in a UE **550**, a processor **590** may be configured to receive and parse the Cell Broadcast Message in accordance with the description below. Furthermore, in various aspects of the disclosure, at least one processor such as in the processing system **114** may be utilized to implement one or more of the processes or functions described below.

Cell Broadcast (CB) service is a feature supported in GSM and UMTS technologies, as defined by the 3GPP standards body. Cell Broadcast service information may be transmitted from a Cell Broadcast Center **250** to nearby UEs **210**, and typically includes information such as the name of the city/region where the cell is located, which may then be visualized on the display of a UE **210**. Typically, CB messages are transmitted to the cell over a cell broadcast channel (CBCH) at 1.88-second intervals.

For the GSM standard, 3GPP TS 44.012, revision 8.8.0, titled "Short Message Service Cell Broadcast (SMSCB) support on the mobile radio interface" and incorporated herein by reference in its entirety, describes the SMS Cell Broadcast Service, as it is implemented in a conventional GSM system according to Rev. 8 standards. The SMS Cell Broadcast service is designed to minimize the battery usage requirements for a UE **210**. The UE **210** can read the first part of a CB message and then decide whether or not to read the remainder of the message. In addition, the network may broadcast Schedule Messages, providing information in advance about the CB messages that will be sent immediately afterwards. The UE **210** may use this scheduling information to restrict reception to those messages relevant to the UE **210**.

CB-DRX is a more recent development for Cell Broadcast messaging, enabling a reduction in receiver power usage at the UE **210** in the cell that receives the CB messages. With CB-DRX, rather than listening to the CBCH at each 1.88-second interval, a Schedule Message provides a schedule for CB messaging, such that the UE **210** can listen to the CBCH more infrequently. The Schedule Message provides scheduling for a predetermined Schedule Period, e.g., including the next 48 slots, for the reading of the CBCH. By utilizing the information in the Schedule Message, the UE **210** may determine which slots on the CBCH carry information for the cell.

One issue with conventional CB-DRX is that if a UE **210** fails to read the Schedule Message, the UE **210** thereafter is generally required to read the CBCH at every 1.88-second interval through all 48 slots, as in non-DRX CB messaging, until it successfully receives a Schedule Message from the network. This scenario can result in a relatively high power consumption and premature battery drain, and essentially frustrates the main purpose of CB-DRX. Furthermore, this scenario can cause page messages directed to the UE **210** to be missed. This problem can become exacerbated in the case of a dual SIM dual standby UE **210**, which may be configured to read the CBCH every 1.88 seconds on both subscriptions, thereby causing a potentially large number of missed pages. Schedule Messages may be missed during cell reselections and during voice calls, for example.

The SMSCB DRX Schedule Message transmitted by a network typically includes information regarding a plurality of consecutive CB messages that are scheduled or planned to immediately follow the Schedule Message. For optimum DRX, a new Schedule Message may follow the last message sent in a Schedule Period. Schedule Messages are sent on basic and extended CBCH independently. When no information is known about a CB message, because no Schedule Message has been received related to the CB message, the UE **210** typically reads at least the first part of the CB message.

According to certain aspects of the present disclosure, a CB Message may be adapted to carry information relating to a schedule for a subsequent CB Message. This information is additional scheduling information that may complement scheduling information provided in a Schedule Message. If a UE **210** fails to receive the Schedule Message, it may determine one or more future time slots in which a subsequent CB Message relevant to the UE **210** may be received. If the UE **210** misses a first Schedule Message, it need not listen to all remaining slots of the 48 slots defined in a Scheduling Period for the next Schedule Message. Rather, the UE **210** typically receives the next CB Message in order to retrieve schedule information corresponding to one or more subsequent CB Messages. The next CB Message may be transmitted in the next slot or in a subsequent slot. Accordingly, the UE **210** may read the CBCH every 1.88 seconds until it receives at least one CB Message. In the next CB Message, the UE **210** may obtain the information indicating when the UE **210** should wake up again to read the CBCH. Thus, certain aspects of the present disclosure enable power savings relative to a conventional CB-DRX-enabled UE **210**.

FIG. **6** is a schematic illustration **600** including a CB Message **620** according to some aspects of the present disclosure. The CB Message **620** may comprise a plurality of blocks **612**, **614**, **616** and **618** and each block may comprise a first octet **610** that serves as at least a portion of a header. In the example depicted, the CB Message **620** comprises 4 blocks **612**, **614**, **616** and **618**, each block **612**, **614**, **616** and **618** having 23 octets, of which the first octet **610** of each block comprises a Block Type. Thus, the first octet **610** of the block in each CB Message **620** comprises a Block Type octet **610** that may identify the function of the block **612**, **614**, **616** or **618**, and certain other attributes of the CB Message **620**.

As depicted in FIG. **6**, the first octet **610** comprises a sequence number field **608**, a last block (LB) field **606**, a Link Protocol Discriminator (LPD) field **604** and a spare field **602**. Bits **1** and **2** of the octet **610**, which are part of the sequence number field **608**, are used to indicate which of four blocks is being received, and bit **4** of the octet **610** may be set to binary 1 when the block belongs to a Schedule Message, and for the purpose of indicating that the block is part of a Schedule Message. The LB field **66** is used to indicate the last block of a CB Message **620** that comprises SMS Cell Broadcast information. The LPD takes the value "0 1" for CB Messages **620**, and other values of LPD indicate other protocols which may cause the CB Message **620** to be ignored when the CB LPD is expected.

In an aspect of the present disclosure, the field **602** (bit **8** of the octet **610**) may be utilized as an indicator to the UE **210** that additional schedule information is included in the CB Message **620**. In one example, the UE **210** may parse the CB Message **620** to determine the schedule information for the next CB Message (not shown) if bit **8** of the first octet **610** is set to binary 1. In conventional systems, bit **8** of the octet **610** is a spare bit that is generally set to zero by the sender and ignored by a conventional receiver. Messages are typically not rejected if this field **602** is assigned a non-zero value.

According to certain aspects of the present disclosure, a Page Parameter may be utilized to explicitly indicate the occurrence of the next CB Message. The Page Parameter may be an element of a 6-octet CB Message Header. In one example, the Page Parameter may indicate the number of slots that will pass before the network is to send the next CB Message relevant to the UE **210**. The Page Parameter may be coded as two 4-bit fields. The first field (bits **0-3**) may indicate the binary value of the total number of pages in a CB Schedule message, and the second field (bits **4-7**) may indicate a specific page number within that sequence. In one example, the coding may start at 0001, with a setting of 0000 being reserved. If a UE **210** receives the code 0000 in either the first field or the second field, then the UE **210** may treat the CB Schedule Message in the same manner that it treats a CB Schedule Message with a page parameter 0001 0001 (i.e., a single page message).

In certain embodiments, the first field or the second field of a Page Parameter may be set to the value 0000 to indicate that the UE **210** may find scheduling information in the CB Message. In this way, existing functionality of conventional UEs is not affected. The content of the scheduling information within the CB Message may be included in any suitable octet within the CB Message. For example, the scheduling information may be transmitted in a predetermined octet within the CB Message **620**, at a bit position known to both the receiving UE **210** and a transmitting entity such as the CBC **250**, the RNC **206**, and/or the Node B **208**.

FIG. **7** is a flow chart illustrating a process **700** of receiving Cell Broadcast Messages in accordance with an aspect of the present disclosure. In various aspects, the process **700** may be implemented by the UE **550**, e.g., by utilizing one or more of the receiver **554**, processor **590**, or any other suitable block within the UE **550**.

At step **702**, the UE **550** may determine if it received a CB-DRX Schedule Message. As described above, the CB-DRX Schedule Message is a conventional message that provides scheduling for the Schedule Period for the reading of the CBCH. If the UE **550** received the CB-DRX Schedule Message, then at step **704**, the UE **550** may follow the schedule provided in the received message. In this way, conventional CB-DRX may be implemented.

If, however, at step **702** the UE **550** did not receive the CB-DRX Schedule Message, then at step **706**, the UE **550** may receive a first CB Message. At step **708**, the UE **550** may parse the first CB Message and extract schedule information indicating a next Cell Broadcast Message, e.g., identifying one or more slots that may carry the Cell Broadcast Message information. Thus, in block **710**, the UE **550** may receive the Cell Broadcast Message according to the schedule extracted in block **708**.

FIG. **8** is a flow chart illustrating a method for receiving CB Messages in accordance with certain aspects of the present disclosure. The method **800** may be performed by the UE **550**, and my employ one or more of the receiver **554**, processor **590**, or any other suitable block within the UE **550**.

At step **802**, the UE **550** may receive a first cell broadcast message. The first cell broadcast message may comprise schedule information indicating timing of a next cell broadcast message or a schedule message. The UE **550** may monitor a communications link in order to receive the first CB Message. The first CB Message may comprise schedule information indicating timing of a next CB message or a Schedule Message. The first CB message may be received before timing information associated with a CB channel is known. The first CB message may be received after a reselection procedure or after termination of a voice call. The Schedule Message may be received and may include timing information for one or more subsequent CB Messages during a scheduling period. In some embodiments, one or more subsequent CB Messages may be received in accordance with the timing information included in the Schedule Message.

The next CB Message or the Schedule Message may be received by monitoring a CB channel at intervals defined by the schedule information in the first CB Message. The first CB message may be received by periodically reading a CB channel until the first CB Message is received. The first CB Message may be identified in a block type octet in the first cell broadcast message.

At step **804**, the UE **550** may receive the next cell broadcast message or the schedule message according to the schedule information in the first cell broadcast message. The UE **550** may parse the first CB Message and extract schedule information indicating the expected timing of next CB Message. In one example, the schedule information may identify one or more slots that carry the CB Message information.

The schedule information in the first CB Message may relate to a DRX schedule defined in a previously missed Schedule Message. The schedule information may have been adapted to identify a slot configured to carry the next CB Message. The schedule information may have been adapted to identify a slot configured to carry the Schedule Message. The presence of the schedule information in the first CB Message may be indicated in a page parameter of a header of the first CB Message.

FIG. **9** is a flow chart illustrating a process **900** of transmitting CB Messages in accordance with certain aspects of the present disclosure. The process **700** may be implemented by network entity such as the Node B **510**, which may utilize, for example, one or more of the transmitter **532**, processor **540**, or any other suitable block within the Node B **510**.

At step **902**, the Node B **510** may transmit a Schedule Message to a UE **550**. The Schedule Message may include scheduling information defining timing for a cell broadcast channel. The scheduling information may define one or more timing slots allocated to carry one or more CB Messages for the UE **550**. The scheduling information may define a DRX schedule for the CB channel.

At step **904**, the Node B **510** may transmit the CB Message subsequent to the Schedule Message. The CB Message may include a portion of the scheduling information transmitted in the Schedule Message. The Node B **510** may adapt the CB Message to include the portion of scheduling information. The portion of the scheduling information may define a slot in the CB channel that is allocated to carry a next CB Message for the UE **550**. The portion of the scheduling information may be adapted to identify a slot allocated to carry a next Schedule Message for the UE. The CB Message may be adapted to include an indicator of presence of scheduling information in a header of the cell broadcast message. The indicator may be provided in a block type octet or in a page parameter field.

FIG. **10** is a diagram **1000** illustrating an example of a hardware implementation for an exemplary user equipment apparatus **1002** employing a processing circuit **1004**. The apparatus **1002** may comprise a UE **550** and may employ one or more of a receiver **554**-processor **590**, memory **592** and other circuits or modules to perform certain of the functions described herein. The processing circuit **1004** may be implemented with a bus architecture, represented generally by the bus **1030**. The bus **1030** may include any number of interconnecting buses and bridges depending on the application and attributes of the processing circuit **1004** and overall design constraints. The bus **1030** may link together various circuits including general-purpose processors **1026** and/or one or more processors **560**, **570**, **590**, **594**, **580**, **582**, and/or other hardware modules **554**, **556**, **572**, **578** that perform specific functions, as well as the computer-readable storage medium **1006**, which may comprise one or more of memory **592**, data source **578** and data sink **572**. The bus **1030** may also link various other circuits such as timing sources, peripherals, voltage regulators, and power management circuits, which are well known in the art, and therefore, will not be described any further.

The processing circuit **1004** may be coupled to one or more transceivers, which may comprise receiver **554** and transmitter **556** and/or other related circuits and modules. The one or more transceivers **1018** may be used for communications between UE **550** and one or more entities **510** of a network.

The processing circuit **1004** may include one or more processors **1026**, **560**, **570**, **590**, **594**, **580**, **582**, which may be responsible for certain general processing tasks, including the execution of software stored on the computer-readable storage medium **1006**. The software, when executed by the one or more processors **1026**, **560**, **570**, **590**, **594**, **580**, **582**, may cause the processing circuit **1004** to perform the various functions described supra for any particular apparatus. The computer-readable storage medium **1006** may also be used for storing data that is manipulated by the processing circuit **1004** when executing software.

The processing circuit **1004** further includes at least one of the modules **1020**, **1022** and **1024**. The modules **1020**, **1022** and **1024** may be software modules running on the processing circuit **1004**, resident/stored in the computer readable storage medium **1006**, one or more hardware modules coupled to the processing circuit **1004**, or some combination thereof. In one configuration, the apparatus **1002** for wireless communication includes means **1020** for receiving CB Messages and Schedule Messages, means **1022** for extracting schedule information from a CB Message, and means **1024** for determining DRX timing information for the apparatus **1002** based on the extracted schedule information.

FIG. **11** is a diagram **1100** illustrating an example of a hardware implementation for an exemplary network access apparatus **1102** employing a processing circuit **1104**. The network access apparatus **1102** may comprise a CBC **250**, an RNC **206**, or a Node B **208**. In the example of a Node B, the apparatus **1102** may employ one or more of a receiver **535**, processor **540**, memory or other storage **542** and other circuits or modules to perform certain of the functions described herein. The processing circuit **1104** may be implemented with a bus architecture, represented generally by the bus **1130**. The bus **1130** may include any number of interconnecting buses and bridges depending on the application and attributes of the processing circuit **1104** and overall design constraints. The bus **1130** may link together various circuits including general-purpose processors **1126** and/or one or more processors **520**, **530**, **540**, **544**, **536**, **538**, and/or other hardware modules **512**, **532**, **546**, **539**, **535** that perform specific functions, as well as the computer-readable storage medium **1106**, which may comprise one or more of memory **542**, data source **512** and data sink **539**. The bus **1130** may also link various other circuits such as timing sources, peripherals, voltage regulators, and power management circuits, which are well known in the art, and therefore, will not be described any further.

The processing circuit **1104** may be coupled to one or more transceivers, which may comprise receiver **554** and transmitter **556** and/or other related circuits and modules. The one or more communications interfaces and/or transceivers **1118** may be used for communications between UE **550** and one or more entities **510** of a network.

The processing circuit **1104** may include one or more processors **1126**, **560**, **570**, **590**, **594**, **580**, **582**, which may be responsible for certain general processing tasks, including the execution of software stored on the computer-readable storage medium **1106**. The software, when executed by the one or more processors **1126**, **560**, **570**, **590**, **594**, **580**, **582**, may cause the processing circuit **1104** to perform the various functions described supra for any particular apparatus. The computer-readable storage medium **1106** may also be used for storing data that is manipulated by the processing circuit **1104** when executing software.

The processing circuit **1104** further includes at least one of the modules **1120**, **1122** and **1124**. The modules **1120**, **1122** and **1124** may be software modules running on the processing circuit **1104**, resident/stored in the computer readable storage medium **1106**, one or more hardware modules coupled to the processing circuit **1104**, or some combination thereof. In one configuration, the apparatus **1102** for wireless communication includes means **1120** for transmitting CB Messages to the UE **550**, means **1122** for transmitting Schedule Messages to the UE **550**, means **1124** for determining slot timing information for the cell.

Several aspects of a telecommunications system have been presented with reference to a W-CDMA system. As those skilled in the art will readily appreciate, various aspects described throughout this disclosure may be extended to other telecommunication systems, network architectures and communication standards.

By way of example, various aspects may be extended to other UMTS systems such as TD-SCDMA and TD-CDMA. Various aspects may also be extended to systems employing Long Term Evolution (LTE) (in FDD, TDD, or both modes), LTE-Advanced (LTE-A) (in FDD, TDD, or both modes), CDMA2000, Evolution-Data Optimized (EV-DO), Ultra Mobile Broadband (UMB), IEEE 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20, Ultra-Wideband (UWB), Bluetooth, and/or other suitable systems. The actual telecommunication standard, network architecture, and/or communication standard employed will depend on the specific application and the overall design constraints imposed on the system.

It is to be understood that the specific order or hierarchy of steps in the methods disclosed is an illustration of exemplary processes. Based upon design preferences, it is understood that the specific order or hierarchy of steps in the methods may be rearranged. The accompanying method claims present elements of the various steps in a sample order, and are not meant to be limited to the specific order or hierarchy presented unless specifically recited therein.

The previous description is provided to enable any person skilled in the art to practice the various aspects described herein. Various modifications to these aspects will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other aspects. Thus, the claims are not intended to be limited to the aspects shown herein, but are to be accorded the full scope consistent with the language of the claims, wherein reference to an element in the singular is not intended to mean "one and only one" unless specifically so stated, but rather "one or more." Unless specifically stated otherwise, the term "some" refers to one or more. A phrase referring to "at least one of" a list of items refers to any combination of those items, including single members. As an example, "at least one of: a, b, or c" is intended to cover: a; b; c; a and b; a and c; b and c; and a, b and c. All structural and functional equivalents to the elements of the various aspects described throughout this disclosure that are known or later come to be known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the claims. Moreover, nothing disclosed herein is intended to be dedicated to the public regardless of whether such disclosure is explicitly recited in the claims. No claim element is to be construed under the provisions of 35 U.S.C. §112, sixth paragraph, unless the element is expressly recited using the phrase "means for" or, in the case of a method claim, the element is recited using the phrase "step for."

The invention claimed is:

1. A method of wireless communication, comprising:

transmitting a schedule message to a user equipment (UE), the schedule message including scheduling information defining timing for a cell broadcast channel; and

transmitting a cell broadcast message subsequent to the schedule message, wherein the cell broadcast message includes a portion of the scheduling information.

2. The method of claim **1**, wherein the scheduling information defines one or more timing slots allocated to carry one or more cell broadcast messages for the UE.

3. The method of claim **1**, wherein the scheduling information defines a discontinuous reception schedule for the cell broadcast channel.

4. The method of claim **1**, wherein the portion of the scheduling information defines a slot in the cell broadcast channel that is allocated to carry a next cell broadcast message for the UE.

5. The method of claim **1**, wherein the portion of the scheduling information is adapted to identify a slot allocated to carry a next schedule message for the UE.

6. The method of claim **1**, wherein the cell broadcast message includes an indicator of presence of scheduling information in a header of the cell broadcast message.

7. The method of claim **6**, wherein the indicator is provided in a block type octet or in a page parameter field.

8. An apparatus configured for wireless communication, comprising:

at least one processor;

a memory coupled to the at least one processor; and

a communication interface coupled to the at least one processor,

wherein the at least one processor is configured to:

transmit a schedule message to a user equipment (UE), the schedule message including scheduling information defining timing for a cell broadcast channel; and

transmit a cell broadcast message subsequent to the schedule message, wherein the cell broadcast message includes a portion of the scheduling information.

9. The apparatus of claim **8**, wherein the scheduling information defines one or more timing slots allocated to carry one or more cell broadcast messages for the UE.

10. The apparatus of claim **8**, wherein the scheduling information defines a discontinuous reception schedule for the cell broadcast channel.

11. The apparatus of claim **8**, wherein the portion of the scheduling information defines a slot in the cell broadcast channel that is allocated to carry a next cell broadcast message for the UE.

12. The apparatus of claim **8**, wherein the portion of the scheduling information is adapted to identify a slot allocated to carry a next schedule message for the UE.

13. The apparatus of claim **8**, wherein the cell broadcast message includes an indicator of presence of scheduling information in a header of the cell broadcast message.

14. The apparatus of claim **13**, wherein the indicator is provided in a block type octet or in a page parameter field.

15. An apparatus configured for wireless communication, comprising:

means for transmitting a schedule message to a user equipment (UE), the schedule message including scheduling information defining timing for a cell broadcast channel; and means for transmitting a cell broadcast message subsequent to the schedule message, wherein the cell broadcast message includes a portion of the scheduling information.

16. The apparatus of claim **15**, wherein the scheduling information defines one or more timing slots allocated to carry one or more cell broadcast messages for the UE.

17. The apparatus of claim **15**, wherein the scheduling information defines a discontinuous reception schedule for the cell broadcast channel.

18. The apparatus of claim **15**, wherein the portion of the scheduling information defines a slot in the cell broadcast channel that is allocated to carry a next cell broadcast message for the UE.

19. The apparatus of claim **15**, wherein the portion of the scheduling information is adapted to identify a slot allocated to carry a next schedule message for the UE.

20. The apparatus of claim **15**, wherein the cell broadcast message includes an indicator of presence of scheduling information in a header of the cell broadcast message.

21. The apparatus of claim **20**, wherein the indicator is provided in a block type octet or in a page parameter field.

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